DOCUMENT RESUME

ED 218 216 SO 014 182

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TITLE The Evolution of Cartography Graduate Programs and the Development of New Graduate Programs in Cartography: An Assessment of Models.
PUB DATE Apr 82
NOTE 15p.; Paper presented at the Annual Meeting of the Association of American Geographers (San Antonio, TX, April 25-28, 1982).

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Cartography; Educational History; *Educational Needs; *Geography Instruction; *Graduate Study; Higher Education; Labor Market; Models; Program Development

ABSTRACT

This paper traces the historical development of cartography graduate programs, establishes an evolutionary model, and evaluates the model to determine if it has some utility today for the development of programs capable of producing highly skilled cartographers. Cartography is defined to include traditional cartography, computer cartography, remote sensing, and geographic information systems. There is a growing demand for cartographers with the highest level of training from academic, government, and private sectors. On the average it appears that we are satisfying about one-fifth to one-sixth of the demand. Reasons why are discussed. The paper then reviews the history of three prominent university cartography programs. The characteristics of the model of program development that can be formed from these past experiences are discussed. For example, the program was hosted by a geography department and evolved slowly from the interests of one faculty member. The model will not work today because it limits new program development to existing Ph.D. granting geography departments, program development is slow, and the body of knowledge and skills that now make up cartography far exceed the mastery of a single faculty member. The author recommends the creation of a new model of program development and discusses five criteria which should be built into this model. The paper concludes with a discussion of where new Ph.D. programs of this nature can be developed. (RM)

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# The Evolution of Cartography Graduate Programs and the Development of New Graduate Programs in Cartography: An Assessment of Models.

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A paper presented at a special session on Cartography vs. Geography organized by the Cartography Specialty Group of the AAG for the San Antonio meetings in April, 1982.

## ABSTRACT

The historical development of cartography graduate programs is traced for the purpose of establishing an evolutionary model. This developmental model is evaluated to see how well and in what ways it has functioned in the past and to see if this model of program evolution has some utility today for the development of programs capable of producing highly skilled cartographers. The advantages and disadvantages of alternative models of cartography graduate program development are discussed. The emphasis throughout is on how graduate programs in cartography have come into existence and how new graduate programs can be developed today in geography departments with only limited cartography offerings.

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# The Evolution of Cartography Programs and the Development of New Graduate Programs in Cartography: An Assessment of Models.

## OUTLINE

I. There is a current need for additional academically trained cartographers.

A. The demand for cartographers.

1. Increased numbers.
2. Increased skill level.
3. Increased variety of skills.

B. The supply of cartographers.

1. How many are being produced?
2. Where are they being produced?

C. What are the causes of the deficiency of cartographers?

1. Rapid growth in demand from many employment sectors.
   a. Private sector.
   b. Government.
   c. Undergraduate and graduate education.
2. Many existing programs cannot train at the state-of-the-art level or are not broad enough to train in all areas of cartography or are being forced to cut back or maintain status quo.
3. Generally depressed economic conditions and the impact on higher education in particular.
4. The less than ubiquitous distribution of existing graduate programs in cartography and the interactive effect with economic conditions.
5. Image problems with the cartographic profession.
6. Economic rewards in the academic profession compared to the rewards in other professions as well as other sectors of cartography with similar training and skill demands,
7. Cut backs in government training programs because of increased cost to provide more sophisticated skill training.

II. The solution to the problem is obvious. We must produce a greater number of academically trained cartographers or we will abdicate this service to another discipline or group of disciplines by default.

A. Does the solution to the problem lie in the past? How have existing graduate cartography programs come into existence?

1. Review of sample graduate cartography program histories.
    a. The Wisconsin program.
    b. The Kansas program.
    c. The Washington program.
2. A model of past program development.
    a. Hosted by a geography department.
    b. Ph.D. in geography preceded cartography specialization.
    c. Evolved slowly from interests of a single faculty member.
    d. Grew as department, faculty, and cartographic profession grew.

B. What is wrong with the model of past program development and why won't it necessarily work today?

1. It limits new program development to existing Ph.D. granting geography departments.
    a. This puts the new program in competition with other existing specializations many of which are of great seniority and reputation.
    b. This still means that there is a less than ubiquitous distribution of programs within the U.S.
    c. New cartography programs could develop in new geography Ph.D. programs of traditional design but we all know the likelihood of these programs being approved since the general demand for geographers is somewhat depressed.
2. Program development is slow requiring years of time to evolve to the point where highly trained specialists can be produced to meet a demand that is underfilled today.
3. The body of knowledge and skills that now make up cartography far exceeds the mastery of a single faculty member.

C. If the solution does not lie in the past and if existing programs are handcuffed for one reason or another, what new options are open to us? What must we do to increase the supply of academically trained cartographers?

1. A new model of program development. Any new program must meet a rather demanding set of criteria in order to fulfill the needs of the cartographic profession and to get support from sponsoring universities.
   a. The program should be broad enough to offer specialized training in major content fields including conventional cartography, computer cartography, remote sensing, and geographic information systems.
   b. The program must be supported by a teaching and research faculty (3-4) that covers the content fields listed above.
   c. Adequate support must be present in the form of staff, space, and equipment to keep the training as near to the state-of-the-art level as possible.
   d. The program should be full-blown from the beginning so that it can be competitive and so it can provide all necessary training otherwise its chance of success will be compromised.
   e. Exhaustive justification must be developed to show university administration and state education officials why this program is needed, why it is not duplicative, what its benefits will be, how much it will cost, and how productive it will be.
2. Where can new programs of this nature be developed?
   a. In geographic areas where the need for trained cartographers is great and where the supply is low but also where the supply of potential cartography students is high.
   b. In areas where economic conditions at the present are best (maybe not good) and where the long term economic prognosis is favorable.
   c. In geography programs where a major commitment has already been made to cartography so that actual costs of the new program will be minimized.
   d. In geography programs that do not currently offer the Ph.D. degree so that the new program does not have to compete with other favored Ph.D. specialties for scarce resources.

e. In geography departments that currently only offer a masters degree a better justification can be made for a new Ph.D. degree with a specialization only in cartography than can be made for a general Ph.D. in geography.

3. If you are in a department which meets some or all of the criteria mentioned here you should consider the development of a new program now or should begin to plan for development in the near future.

4. The development of new programs following this model is not easy but should more programs in cartography come into existence in this way the supply of cartographers should be increased and the cartographic profession as well as geography would maintain significant control over the training of cartographers. If we do nothing to increase the supply of cartographers we encourage other disciplines to take over the task and we encourage the pirating of Ph.D. cartographers from the academic setting to private industry thereby reducing further our ability to train new cartographers.

5. The next few years will be critical for the cartographic profession. We are going to have to look at all possible ways of upgrading the quality of cartographic education and at ways of producing more cartographers.

A recent review of job listings for cartographers with doctoral training and of a listing of recent Ph.D. recipients from cartography programs has revealed a gross demand/supply imbalance. This probably comes as no great surprise to most cartographers but I do not believe enough attention has been paid to the problem by the cartographic profession. Do we know what the causes of this imbalance are? Do we appreciate the implications of our continued inability to supply a commodity in great demand? Have we taken the time to try to identify and implement solutions to the problem? I suspect the answers to these and other related questions is no! Why? Many of us gathered here today are educators responsible for the training of future cartographers. Is it possible we have been lulled into a false senseof professional security or mesmerized by a demand for our skills and the end products of our pedogodgic efforts? How many of us have allowed ourselves an inner smerk when the most recent Jobs in Geography arrives loaded with fresh ads for cartographers. A few of us may be able to tick off the current job openings mentally or may have even underlined them in the AAG Newsletter. Who of us hasn't taken a slightly holier-than-thou attitude towards another sub-discipline of geography or towards a fellow faculty member in that sub-discipline who hasn't seen a new job listing in his field in the last two years? We work hard to improve our courses and to push back research frontiers but seldom do we take the time to look at the big picture and the problem of supply and demand of cartographers. Surely we must realize that when a commodity is consistently in short supply one or more of a number of reactions take place. 1) the commodity looses its utility, 2) another commodity will be substituted for it, or 3) someone else will take over the production of the com-

modity. I don't think that we as a profession want any of these things to take place so let us begin by examining the problem.

For the purpose of this assessment I am going to use a fairly broad definition of cartography which includes traditional cartography, computer cartography, remote sensing, and geographic information systems. It seems to me that this broad definition is appropriate today even though considerable specialization has taken place because from an educational point of view we must show how these components of geographic information processing fit together into a single, whole activity and the most generally accepted term for this activity is cartography. Also for the purpose of this assessment I am going to deal with the production of Ph.D. cartographers but obviously the production of cartographers at other educational levels is closely related.

Let us look first at the current demand for cartographers. Over the past six years the total number of academic jobs advertised in Jobs in Geography has averaged 210. Of those jobs, on the average, 57 have been for a person trained in cartography. This means that over the past six years about 28% of all the jobs advertised were for someone with this specialty. Over the six year period there was a total of 343 academic jobs listed for Ph.D. level cartographers. Although the actual number of new job openings is considerably less than that because of the domino effect of a cartographer in an existing position moving to a new job and thus creating another opening, and also because the same job may have been listed more than once over the six year period we still have, after deflation, a very large demand for this specialization. The nature of the advertised jobs has also changed over the six year period. There has been increasing demand, as revealed by the job de-

scriptions, for people holding the doctorate and less interest or willingness to advertise for people who are ABD. Job descriptions also indicate the desire for people who possess a particular set of skills and also a greater variety of skills. For example, the recent ads specify not just a cartographer but a cartographer able to teach computer cartography or who is familiar with computer graphics. They also seek a specialist in digital remote sensing not just someone in remote sensing. Specialization is in demand, and in many areas within cartography. Keep in mind that what I have enumerated here is only an academic demand for cartographers. There is also a growing demand for cartographers with the highest level of training from the private and government sectors but I will say more about that in just a minute.

What is the supply situation? Of the 130 Ph.D. degrees granted in geography departments during 1981 only 12 or a little over 9% were in some area of cartography. In 1980 there were 11 and in 1979 there were 10. On the average it appears that we are satisfying about one-fifth to one-sixth of the demand.

What are the causes for this deficiency? The six reasons that I feel are most important include:

1) a rapid growth in demand from several employment sectors.

The private sector has recently come to value the professionally trained cartographer. This applies especially to organizations with large resource holdings, such as lumber, mining, or power generating companies, and to those with extensive transportation networks. Many of these companies initially purchased computer graphics systems with some mapping capability, but they have begun to realize that maximum benefits accrue from these systems when they are managed and operated

by experienced cartographers. Private planning companies are especially significant employers of cartographers, and demand for such planning services is expected to increase in the future. Continued growth in the size and complexity of business operations will increase the need for analysis, synthesis, and organization such as that provided by a competent cartographer.

The Federal Government has employed thousands of people with the job title "Cartographer" for many years. Most of these people had little formal training in cartography at the university level; they were trained by government agencies, often "on-the-job." This was satisfactory until recently, when highly technical map production methods were developed and adopted by these mapping agencies. The Federal Government subsequently is revising its cartographer job description to be more consistent with current needs.

At the state and local levels of government the need for trained cartographers has exceeded the supply for several years. Those trained at both undergraduate and graduate levels have been in great demand.

Nationally, universities will be the major suppliers of highly skilled cartographers but they will also be major consumers. Many of the smaller undergraduate geography departments that offer course work in cartography do so with inadequately trained personnel. Often a new faculty member with only a marginal interest in cartography has been appointed to teach cartography courses, generally with unsatisfactory results. Many of these departments will replace faculty through attrition with people who have specialized in cartography at the doctoral level.

In Ph.D. departments cartographers will be needed to broaden offerings and to add depth in key demand areas.

2) A second reason for the deficiency is that many existing cartography programs cannot train at, or even near, the state-of-the-art level. Many are using out of date equipment and must rely on faculty that are not familar with the latest technology. Many programs are also not broad enough to cover all areas of cartography. Aggravating this situation are conditions which force departments to cut back support to these programs or at best maintain the status quo.

3) Generally depressed economic conditions have had a serious impact on higher education. Enrollment is down as education is deferred to a later, and hopefully more prosperous, time or because some people have chosen an alternative vocation with a more immediate economic gain.

4) In part we do not produce enough cartographers because of the sparse and unequel distribution of existing programs. A larger number of programs, properly placed, would tap a larger population of potential cartographers. Proximity to a program may be a bigger factor than we think, particularly during difficult economic times. The fact that many of the major cartography programs are located in some of the most economically hard pressed areas doesn't help the situation either.

5) Cartography suffers from image problems. Outside of geography and perhaps a few other disciplines, few people know what cartography is and what cartographers do.

6) Generally economic rewards in the academic profession are smaller than those in other professons or in other sectors of cartography with comparable training and skill level requirement.

I am sure you could think of other reasons. The solution to the problem is obvious. We must produce a greater number of academically trained cartographers or we will abdicate this service to another discipline or group of disciplines. We could do this in a number of ways.

The productivity of existing programs could be increased but there are limits to what extent this can be done. Some of these programs are already finding it difficult to replace aging equipment or to add new courses. New faculty positions are out of the question. A better solution is to broaden the support base of cartography by tapping new resources. This can be done best by developing new programs. But how can we do that? Perhaps we can learn from the past. How have existing graduate cartography programs come into existence?

Let me briefly review the history of a few prominent cartography programs and then develop a model of past program development. The three programs are Wisconsin, Washington, and Kansas. The geography department at Wisconsin became an entity unto itself in 1928 when geography split from geology. The first Ph.D. in geography, however, had been completed some 12 years earlier in 1916. The first cartographer was hired in 1945 but it was not until 11 years later in 1956 that the first Ph.D. in cartography was completed. The geography department at Washington split from geology in 1935 but like Wisconsin the first Ph.D. was completed before that, in this case in 1930. The first cartographer-to-be was hired in 1942 and the first Ph.D. in cartography was granted 16 years later in 1958. At Kansas the geography department evolved from geology in 1947 and the first cartographer-to-be was hired two years later in 1949. The first geography Ph.D. was granted in 1958 and the first Ph.D. in cartography was granted in 1967. The model of program development that can be formed from these past experiences exhibits the following characteristics:

1. The program was hosted by a geography department.
2. The Ph.D. in geography preceeded the cartography specialization by many years.

3. The cartography program evolved slowly from the interests of a single faculty member.

4. The cartography program grew as the geography department, the individual faculty member, and the cartographic profession grew.

Will such a model of program development work today? I think not. First of all it limits new program development to existing Ph.D. granting geography departments. This puts a new cartography program in competition for scarce resources with other existing specializations many of which are likely to be of great seniority or reputation. Second of all, program development is slow, requiring years of time to evolve to the point where highly trained specialists can be produced to meet a demand that is underfilled today. Third, the body of knowledge and skills that now make up cartography far exceeds the mastery of a single faculty member.

If the solution does not lie in the past and if existing programs are handcuffed for one reason or another, what new options are open to us? Perhaps we can develop a new model of program development. It seems to me that any new Ph.D. program must meet a rather demanding set of criteria in order to fulfill the current needs of the cartographic profession and to get support from sponsoring universities. These criteria should be built into our model.

1) The program should be broad enough to offer specialized training in major content fields including conventional cartography, computer cartography, remote sensing, and geographic information systems.

2) The program must be supported by a teaching and research faculty that covers the content fields listed above.

3) Adequate support must be present in the form of staff, space, and equipment to keep the training at near to the state-of-the-art level as possible.

4) The program should be full-blown from the beginning so that it can be competitive and so it can provide all necessary training, otherwise its chance of success will be compromised.

5) The new program should be housed in a geography department but it should stand alone and not be encumbered by other specializations in geography for which there is little demand. To bring this program into existence exhaustive justification must be developed to show university administration and state education officials why this program is needed, why it is not duplicative, what its benefits will be, how much it will cost, and how productive it will be.

Where can new Ph.D. programs of this nature be developed?

1) In geographic areas where the need for trained cartographers is great and where the supply is low but also where the supply of potential cartography students is high.

2) In areas where economic conditions at the present are best (maybe not good) and where the long term economic prognosis is favorable.

3) In geography programs where a major commitment has already been made to cartography so that actual costs of the new program will be minimized.

4) In geography programs that do not currently offer the Ph.D.

degree so that the new program does not have to compete with other favored Ph.D. specialties for scarce resources.

5) In geography departments that currently offer only a masters degree a better justification can be made for a new Ph.D. degree with a specialization only in cartography than can be made for a general Ph.D. in geography.

If you are in a department which meets some or all of the criteria mentioned here you should consider the development of a new program now or should begin to plan for development in the near future. Leadership for developing the program will have to come from you but you will need the support of your entire department. The development of new programs following this model is not easy, but should more programs in cartography come into existence in this way the supply of cartographers will increase and the cartographic profession as well as geography will maintain significant control over the training of cartographers. If we do nothing to increase the supply of cartographers we encourage other disciplines to take over the task and we encourage the pirating of Ph.D. cartographers from the academic setting to private industry thereby reducing further our ability to train new cartographers. The next few years will be critical for the cartographic profession. We are going to have to look at all possible ways of upgrading the quality of cartographic education and at ways of producing more cartographers. Let us begin!